of the hexamethylene ring. 'Dextro' and 'lævo' menthone are shown to be not true optical isomens. Several other cases of rotation change were noted, and found to be due in general to chemical alteration of the nucleus.

The author emphasized the value of geometric formulæ, and especially a modification of the Kekulé-Baeyer tetrahedral models, and showed that certain plane formulæ, which have been seriously discussed, are impossible of construction by the models, and must be considered as, at least, improbable.

The Determination of Formaldehyde: R. H. WILLIAMS.

The author gave the results of a critical study of four of the more commonly used methods for the determination of formaldehyde. Two of these, the 'iodimetric' and the 'hydrogen peroxide' being oxidation methods, while the other two, the 'potassium cyanide' and Leglers's 'ammonia' methods, are based upon condensation reactions. The oxidation methods were found in all cases to give noticeably higher results than the condensation methods. Test analyses made with the addition of alcohol, aldehydes and acetone indicated that the difference was not due to the influence of other substances present in the formaldehyde solution, but to the reactions on which the methods are based. Paraformaldehyde may be determined as readily as formaldehyde, with any of the four methods mentioned. The formation and properties of the hexamethylene-tetramine, on which the ammonia method depends, will be studied further.

H. C. SHERMAN,
Secretary.

DISCUSSION AND CORRESPONDENCE.

ASYMMETRON LUCAYANUM IN BERMUDA.

BESIDES establishing the fact that *Amphioxus caribæus*—known since 1876 to exist at the Flatts—is found in numerous localities in these islands, the work of the station this year has resulted in the discovery that another representative of this very interesting group of Chordates—*Asymmetron lucayanum*—is also found in these waters. Especial credit for the discovery of this more rare animal is due to Mr. Louis L. Mowbray, a young Bermudian naturalist in the employ of the station.

E. L. MARK,
Director.

BERMUDA BIOLOGICAL STATION,
FLATTS, BERMUDA, July 22, 1904.

THE ASCENT OF WATER IN TREES.

TO THE EDITOR OF SCIENCE: It would not be necessary to notice at all the note on 'The Ascent of Water in Trees,' published in your issue for July 22, were plant physiologists and physicists alone to be considered. A single remark, for the benefit of those who might be misled, will suffice to show the futility of the theory proposed. The structures at the lower end of the conducting tissues are essentially identical with those at the upper end. If at the upper end the 'water ducts are protected from direct atmospheric pressure by their structures,' they are equally shielded from it below.

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CONCERNING SPECTACLES.

RATHER an extensive literature exists on the question raised by Dr. C. Barck in his paper on 'The History of Spectacles' (SCIENCE, XX., July 8, 1904, p. 50) as to whether Nero was near-sighted and viewed gladiatorial combats with glasses. The passages in Pliny's 'Natural History' which have furnished food for this discussion occur in xi. 54, and xxxvii. 16; and the best interpretation thereof known to the writer of the present paragraph is found in Dr. August Nies's interesting thesis 'Zur Mineralogie des Plinius,' pp. 18–20 (Mayence, 1884). The claims of other alleged inventors of spectacles besides those mentioned by Dr. Barck are considered more or less fully in Beckmann's 'History of Inventions,' and in J. Fiedler's 'Geschichte der Erfindung der Fernröhre.'

C. R. E.

SPECIAL ARTICLES.

THE FORMATION OF TOXIC PRODUCTS BY VEGETABLE ENZYMES.

No subject in the domain of plant chemistry has aroused more discussion of late than the physiological rôle of the various enzymes.

Concerning the specific action of a few vegetable ferments, such as diastase, invertase and lipase, a fairly clear and definite idea has been formed, but as regards the functions of other enzymes, particularly those of oxidizing and reducing properties, our knowledge is much less precise, and the greatest diversity of opinion prevails.

As an example of the confusion which exists it is only necessary to review what has been written within the past few years regarding *catalase*. The property which extracts from animal and vegetable tissues possess of decomposing hydrogen peroxide was observed by Schoenbein in 1863, but Loew* was the first to ascribe the reaction to a specific enzyme—catalase—to which he attributed both oxidizing and reducing properties. Loew is of the opinion that, in the respiration processes of the living cell, hydrogen peroxide is formed and that this compound would act detrimentally were it not for the fact that it is destroyed immediately by the catalase. A similar view is shared by Pozzi-Escot,† who, however, declares that catalase is a reducing enzyme and has no oxidizing properties. Kastle‡ and Loevenhart, on the other hand, believe that catalase is concerned purely with oxidation phenomena and that Loew's suggestion, that it prevents the accumulation of hydrogen peroxide, is highly improbable. Without desiring to controvert any of the above opinions, I would like to suggest another possible explanation as to the rôle of the oxidizing and reducing enzymes.

In the course of experiments with sugar cane I have frequently observed that cane, which had been sterilized by steaming, suffers a more rapid deterioration through the attack of molds and bacteria than raw cane. This also holds true, but less noticeably, of the juices from steamed and raw cane. Another observation frequently made was that the juice from the upper green portion of a living cane was more resistant towards fermentation than juice from the riper joints lower down. The juice from the top of the cane also underwent a very rapid darkening after pressing, while that from the middle and bottom exhibited this change to a much less degree. The juice from steamed cane undergoes no coloration whatever. The change in color, resulting from the exposure of the juice or tissues of the cane to the air, is much better observed if the stalk be divided lengthwise; the darkening begins almost instantly in the region of the apex or growing point, and is less and less marked towards the bottom of the stalk. Such coloration phenomena are common to the tissues and juices of most plants and, according to Bertrand, are to be explained by the action of an oxidizing enzyme upon bodies of a tannin nature. Such bodies occur in fact in the sugar cane, and microchemic tests show them to be most abundant in the growing parts.

From the association of coloration phenomena with resistance to fermentation, it is natural to conclude that the dark-colored oxidation products produced by enzymes may have a toxic or germicidal action. That germicidal products, of even a very pronounced character, may be formed in cane juice by enzyme action was shown as follows: Samples of raw and sterilized juice from ripe cane were treated respectively with 0.2 per cent. of resorcin, orcin, pyrogallol and hydroquinone, and left exposed to the air. In every instance the sterilized juices began to ferment first; as regards the raw juices, those treated with resorcin and orcin showed the least resistance to fermentation and those treated with pyrogallol and hydroquinone the greatest. The raw juice treated with hydroquinone turned nearly black in color and remained perfectly preserved for many weeks. In this case the toxic agent was no doubt quinone, the presence of which was plainly indicated by the odor. In the oxidation processes which take place, through enzyme action, when the tissues of green plants are cut or bruised, a quinone body may be formed, or, perhaps, an organic peroxide of the asymmetric peracid

* Loew, U. S. Dept. Agr. Report No. 68. 'Catalase, a New Enzyme of General Occurrence.'

† Pozzi-Escot, *American Chemical Journal*, June, 1903, p. 552.

‡ Kastle and Loevenhart, *American Chemical Journal*, June, 1903, p. 583.

type, which latter group Freer* and Novy have demonstrated to be among the strongest germicides known. The formation of such toxic products would be of immense value to plants in protecting them against infection by micro-organisms, when their tissues are injured. Such protection would be most necessary in the regions of intense growth, and there in fact we find the oxidizing effect of the vegetable enzymes to be the greatest. The toxic products formed would undoubtedly have an injurious action upon the plant itself, were this not prevented by the reducing enzymes, which prevent the diffusion of these substances beyond their points of formation and requirement.

The oxidizing enzymes, no doubt, take part in other important physiological processes besides that of promoting the formation of toxic products. The importance of the latter function seems, however, to have been generally overlooked, and I believe it to constitute a phase of enzyme action well worthy of future investigation.

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THE ENDOSPERM ENZYME OF PHŒNIX DACTYLIFERA—PRELIMINARY REPORT.

THE presence of an enzyme in the resting endosperm of the date seed has been demonstrated as follows: After the embryos were excised from a quantity of seeds the endosperms were ground to a coarse powder and this powder digested cold for six hours with distilled water. The aqueous extract thus obtained was made 40 per cent. alcoholic, after which precipitate No. 1 settled. This precipitate was collected over asbestos and washed with alcohol while the filtrate No. 1 was raised to 80 per cent. alcoholic, after which precipitate No. 2 settled. This precipitate No. 2 was collected over asbestos and washed with alcohol. A portion of precipitate No. 1 was digested with 95 per cent. alcohol with constant shaking for fifteen minutes. The extract was filtered and evaporated to dryness over steam. A very slight residue remained which was insoluble in water and probably consisted of very fine asbestos which passed through the filter. This residue insoluble in water would not affect Fehling's solution, as was expected. The remainder of precipitate No. 1 was extracted with water and the extract filtered. The filtrate was made 50 per cent. alcoholic and digested ten days at laboratory temperatures, after which time it was evaporated to dryness over steam, yielding residue No. 1. This residue was digested for several hours with 95 per cent. alcohol, the extract filtered and evaporated to dryness, yielding residue No. 2, which was found to be very soluble in water and to reduce Fehling's solution. Precipitate No. 1, consisting of carbohydrates insoluble in 40 per cent. alcohol and any proteid either insoluble or carried down with the carbohydrates—evidently during the ten days' digestion in 50 per cent. alcohol—developed a reducing sugar soluble in 95 per cent. alcohol. Precipitate No. 2 was extracted with water and the extract filtered. The filtrate thus obtained was measured equally into four flasks. Into each flask 5 c.c. of soluble starch was titrated. Flasks A and B were immediately made 80 per cent. alcoholic. Flasks C and D remained without alcohol. All four flasks were digested at 40° C. for six hours. The solutions were then evaporated to dryness, yielding residues A_1, B_1, C_1, D_1. Each of these residues was then digested for several hours with 95 per cent. alcohol. The extracts were filtered, and after evaporation to dryness the residues A_2, B_2, C_2, D_2 thus obtained were dried for one hour at 110° C., removed to desiccator and weighed with following results. $A_2 = 0.0085$ gms., $B_2 = 0.0090$ gms., $C_2 = 0.0080$ gms. and $D_2 = 0.0085$ gms. All of these residues were soluble in water and reduced Fehling's solution with a total of 0.0030 gms. of CuO. Whether this reducing sugar developed from the soluble starch or from the carbohydrates present in precipitate No. 2 is unknown. Evidently the activity of the enzyme contained in precipitate No. 2 is not inhibited by 80 per cent. alcohol.

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* Freer and Novy, *American Chemical Journal*, 27, 161–192.